



Application No. 09/812065
Amendment dated: February 8, 2005
Amendment following notice of allowance

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application.

LISTING OF CLAIMS:

1 (previously presented). A micro-analytical apparatus for mechanically manipulating fluid samples, comprising:

a substrate having at least first and second covered channels, each having openings at opposite ends thereof, said first and second covered channels intersecting to form a common intersection with at least four arms;

wherein at least three of the openings of said first and second covered channels are connected to a multi-port valve to control the pressure in the channels, said multi-port valve having at least eight ports; and said multi-port valve being the sole actuator controlling the direction of flow of fluid samples in all the arms of said intersection, and controlling the directions of flow in all of said arms simultaneously; and

wherein said multi-port valve is switchable between:
a first position, wherein the multi-port valve provides a path for mechanical pumping of a first fluid through said multi-port valve in said first covered channel, while a first opening of said second covered channel is

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connected through said multi-port valve to mechanical pumping means and the second opening of said second covered channel is directly connected to mechanical pumping means so as to pinch said first fluid sample at said common intersection; and

a second position where the openings of said first covered channel are connected through said multi-port valve so as to form a closed loop, while said first opening of said second covered channel is disconnected from any mechanical pumping means and the second opening of said second covered channel is directly connected to a mechanical pumping means so as to transport a second fluid in said second covered microchannel while maintaining constant pressure in both arms of said first channel.

2(previously presented). The apparatus of claim 13, wherein the substrate is made of a substance selected from the group consisting of glass, silicon, ceramics, organic polymers, metallic materials and mixtures thereof.

3(previously presented). The apparatus of claim 13, wherein the channels in the substrate are covered by lamination, thermal bonding, anodic bonding, electrostatic interaction, pressure or a combination thereof.

4(Cancelled).

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5(previously presented). The apparatus according to claim 13, wherein the first or second covered channel contains a detection region.

6(previously presented). The apparatus according to claim 5, wherein the detection region consists of electrodes, or a window for spectroscopic detection.

7(previously presented). The apparatus according to claim 13, wherein the first or second covered channel is connected to a detection device.

8(previously presented). A method of manipulating fluid samples using the apparatus of claim 1 comprising the steps of:

- a. mechanically pumping an eluent solution into one end of the first covered channel and through the intersection while applying pressure to both ends of the second covered channel when the multi-port valve is in a first position;
- b. then switching the multi-port valve to a second position so that a sample solution is pumped into the second covered channel through an opening at one end thereof while pressure is applied at the other three openings; and
- c. switching the multi-port valve back to the first position so that the sample is pushed from one arm of the second channel of the device into the intersection and along the first covered channel.

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9(previously presented). The method according to claim 8, wherein an electrical field is applied in a portion of said first or second covered channel in order to sustain or stop the flow of solution therein during the pushing of the sample along the first covered channel.

10(canceled).

11(previously presented). The method according to claim 8, wherein in step (c) the sample is pushed from one arm of the second covered channel of the device into the intersection and along the first covered channel by means of electrophoresis or electro-osmosis.

12(previously presented). The method of claim 8, wherein at least part of the first or second covered channel contains a stationary phase in order to perform chromatography, electrochemistry, electrophoresis, immunological or enzymatic analysis or any combination thereof.

13(Previously presented). A micro-analytical apparatus for mechanically manipulating fluid samples, comprising:
a substrate having at least first and second covered channels, each having openings at opposite ends thereof, said first and second covered channels intersecting to form a common intersection with at least four arms;
wherein at least three of the openings of said first and second covered channels are connected to a multi-port

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valve to control the pressure in the channels, said multi-port valve having at least eight ports; and said multi-port valve being the sole actuator controlling the direction of flow of fluid samples in all the arms of said intersection, and controlling the directions of flow in all of said arms simultaneously; and

wherein said multi-port valve is switchable between:

a first position, wherein the multi-port valve provides a path for mechanical pumping of a first fluid through said multi-port valve in said first covered channel, while the openings of said second covered channel are connected through said multi-port valve so as to form a closed loop; and

a second position, wherein the openings of said first covered channel are connected through said multi-port valve so as to form a closed loop, while the multi-port valve provides a path for mechanical pumping of a second fluid through said multi-port valve in said second covered channel.

14(cancelled).

15(new). The apparatus of claim 1, wherein the substrate is made of a substance selected from the group consisting of glass, silicon, ceramics, organic polymers, metallic materials and mixtures thereof.

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16(new). The apparatus of claim 1, wherein the channels in the substrate are covered by lamination, thermal bonding, anodic bonding, electrostatic interaction, pressure or a combination thereof.

17(new). The apparatus according to claim 1, wherein the first or second covered channel contains a detection region.

18(new). The apparatus according to claim 17, wherein the detection region consists of electrodes, or a window for spectroscopic detection.

19(new). The apparatus according to claim 1, wherein the first or second covered channel is connected to a detection device.

20(new). A method of manipulating fluid samples using the apparatus of claim 13 comprising the steps of:

- a. mechanically pumping an eluent solution into one end of the first covered channel and through the intersection while applying pressure to both ends of the second covered channel when the multi-port valve is in a first position;
- b. then switching the multi-port valve to a second position so that a sample solution is pumped into the second covered channel through an opening at one end thereof while pressure is applied at the other three openings; and

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- c. switching the multi-port valve back to the first position so that the sample is pushed from one arm of the second channel of the device into the intersection and along the first covered channel.

21(new). The method according to claim 20, wherein an electrical field is applied in a portion of said first or second covered channel in order to sustain or stop the flow of solution therein during the pushing of the sample along the first covered channel.

22(new). The method according to claim 20, wherein in step (c) the sample is pushed from one arm of the second covered channel of the device into the intersection and along the first covered channel by means of electrophoresis or electro-osmosis.

23(new). The method of claim 21, wherein at least part of the first or second covered channel contains a stationary phase in order to perform chromatography, electrochemistry, electrophoresis, immunological or enzymatic analysis or any combination thereof.